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## ORIGINAL RESEARCH PAPER

# First record of *Hericium flagellum* (Basidiomycota) from the “Olbina” nature reserve in Wielkopolska Voivodship, Poland

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**Abstract**

*Hericium flagellum* (Scop.) Pers. is considered a rare, wood-decaying fungus that occurs on coniferous trees, predominantly on silver fir (*Abies alba*). In this paper, a new locality of *H. flagellum* in Wielkopolska Voivodship is presented, along with the macro- and micromorphological features of the collected specimens. Basidiomata of *H. flagellum* were found in November 2016 and 2017 in the “Olbina” nature reserve (ATPOL Dc-97, Kalisz Forest District), located in a continental mixed coniferous forest close to the northern border of the natural range of silver fir. In 2016, *H. flagellum* was found growing in the hollow of an old stump of silver fir, and in the following year, this fungus was recorded on a fallen log of silver fir. The implications for conservation are briefly presented. Prospects of further development of the basidiomata of *H. flagellum* in the “Olbina” reserve are also discussed.

**Keywords**

*Hericium alpestre*; *Abies alba*; silver fir; wood-decaying fungi; threatened species

**Introduction**

*Hericium flagellum* (Scop.) Pers. (syn. *Hericium alpestre* Pers.) is one of the four species of the genus *Hericium* reported from Poland [1], along with *H. coralloides* (Scop.) Pers., *H. erinaceus* (Bull.) Pers., and *H. cirrhatum* (Pers.) Nikol. [syn. *Creolophus cirrhatus* (Pers.) P. Karst.]. *Hericium flagellum* is characterized by spherical or irregularly shaped cream-colored basidiomata, up to 30 cm in diameter [2]. Their numerous branches terminate in thin grouped tufts, with pendulous spines that resemble icicles. Usually, *H. flagellum* produces a single basidioma; however, sometimes several specimens can be found on the same piece of wood. In contrast to other *Hericium* spp., *H. flagellum* is found primarily on dead coniferous wood such as logs and stumps. It is rarely found on living trees, and when it is found, it usually appears in tree hollows or trunk wounds. *Hericium flagellum* is predominately found on silver fir (*Abies alba* Mill.); thus, its distribution in Poland and other European countries is closely connected with the natural range of this tree. An alternative host tree of *H. flagellum* is the Norway spruce (*Picea abies* L. H.Karst) [1–4]. A record each of *H. flagellum* is also known from the Swiss stone pine (*Pinus cembra* L.) and the Siberian fir (*Abies pichta*) [5]. In Poland, *H. flagellum* is reported from coniferous and mixed forests with silver fir, e.g., upland mixed fir forest *Abietetum polonicum* (Dziub. 1928) Br.-Bl. et Vlieg. 1939 [6–8], lower montane spruce-fir forest *Abieti-Piceetum montanum* Szaf., Pawł. et Kulcz. 1923 em. J. Mat. 1978 [9,10], continental oak-pine forest *Quercus robur-Pinetum* (W. Mat. 1981) J. Mat. 1988 [11,12], and rich Carpathian beech forest *Dentario glandulosae-Fagetum*

W. Mat. 1964 ex Guzikowa et Kornaś 1969 [7–10,13–15]. Because the distribution of *H. flagellum* is primarily associated with the natural range of silver fir, this fungus is most frequently recorded in the mountains [7,9,10] and uplands [13,16]. Thus far, *H. flagellum* has not been reported from the northern part of Poland, despite the presence of numerous mature stands of silver fir growing in the region of Pomerania, outside the native range of this tree [17]. Within the natural range of silver fir in Europe, *H. flagellum* was also recorded in Austria [18], Bulgaria [19], Croatia [20], France [21], Germany [3,22], Switzerland [2], the Czech Republic [23], Italy [21], Romania [24], Slovakia [25: p. 24–31], Spain [26], and Ukraine [21,27]. Outside the natural range of silver fir, this fungal species was found in the Asiatic area of Russia [5].

In scientific literature, *H. flagellum* has sometimes been described as *Herichium coralloides* (Scop. ex Fr.) S. F. Gray. [9,28,29]. Additionally, the macromorphological similarity of the basidiomata of *H. flagellum* and that of *H. coralloides* (Scop.) Pers. (found mostly on beech and other deciduous wood), along with the use of the same scientific name with the frequent exclusion of the author's names, has caused problems with their designation to the correct species [24,30]. Moreover, some previous authors did not include information on the substrate preferences of the basidiomata or on their microscopic structure. Finally, if herbarium specimens are in poor condition or missing, reliable verification of data on the distribution of both species is impossible.

In this paper, we describe a new locality of *H. flagellum* from Wielkopolska Voivodship (western Poland), discovered in the “Olbina” nature reserve during field trips aimed at determining the diversity of macrofungi in continental mixed coniferous forests. To clearly demonstrate that we have positively identified *H. flagellum*, macro- and micromorphological features of the collected basidiomata are also presented.

## Material and methods

Basidiomata of *H. flagellum* were found in the “Olbina” nature reserve, which was established in 1958 to protect silver fir at the northern limit of its natural range. The first written record concerning this interesting old-growth forest with silver fir in Wielkopolska Voivodship dates back to the interwar period when in 1937 a short description of this forest stand was published [31]. Currently, the “Olbina” reserve covers 16.63 ha within the Kalisz Forest District, near the village of Pieczyska within Kalisz County (ATPOL square Dc-97). The reserve protects the best-preserved patch of continental mixed coniferous forest *Festuco ovinae-Pinetum* (Juraszek 1928) Kobendza 1930 in Wielkopolska Voivodship, featuring a significant contribution of silver fir [32]. According to the reserve's protection plan, the substantial share of silver fir and spruce in the forest stand makes it floristically similar to the upland mixed fir forest [*Abietetum albae* Dziub. 1928 = *Abietetum polonicum* (Dziub. 1928) Br.-Bl. Et Vlieg. 1939]. Additionally, two species characteristic of fir forests are found here: *Lycopodium annotinum* and *Thuidium tamaricinum*. The forest stand is dominated by species that are characteristic of coniferous forests (class *Vaccinio-Piceetea*) [33]. The forest stand of the reserve, aged approximately 176 years, is clearly distinct from the surrounding managed pine forests.

Basidiomata of *H. flagellum* were found in November 2016 and 2017. The description of the basidiomata morphology is based on the original material sampled in the “Olbina” nature reserve and on the information from the literature [2,21]. The microscopic structures were observed and measured using an Olympus BX53 light microscope (LM) coupled with an Olympus DP26 digital camera. The reported size of the spores, basidia, and gloeocystidia are based on 20–30 measurements. Size ranges of the microscopic features are given as follows: (minimum value–)first decile–ninth decile(–maximum value). Scanning electron microscope (SEM) micrographs were taken using a Zeiss EVO LS10 at the Center for Molecular Biology and Biotechnology, Environmental Testing Laboratory, University of Szczecin (Poland). The specimens were identified by examining their macroscopic and microscopic features and using monographs by Breitenbach and Kränzlin [2] and Bernicchia and Gorjón [21]. The fungal nomenclature and its synonyms follow the description in the Index Fungorum [34] and Species Fungorum [35] databases, and the names of vascular plants follow

the description by Mirek et al. [36]. The nomenclature of plant communities was given according to Matuszkiewicz [32]. The collected specimens of *H. flagellum* were deposited in the Herbarium of the Department of Botany and Nature Conservation, University of Szczecin (SZUB). The occurrence of *H. flagellum* in Wielkopolska Voivodship is shown on the cartographic map (Fig. 1) according to the ATPOL grid square system as used by Wojewoda [37].



**Fig. 1** Distribution of *Hericium flagellum* in Wielkopolska Voivodship (blue line – northern limit of the natural range of *Abies alba* in Poland [61]; green area – Wielkopolska Voivodship; red star – the “Olbina” nature reserve).

## Results

### Species description

*Hericium flagellum* (Scop.) Pers., Comm. fung. clav. (Lipsiae): 25 (1797) – Hericiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi [34].

**Synonymies.** *Dryodon alpestris* (Pers.) Pilat, Mykologia (Prague) 8: 53 (1931); *Hericium alpestre* Pers., Mycol. eur. 2: 151 (1825); *Hericium abietis* f. *alpestre* (Pers.) D. Hall & D. E. Stuntz, Mycologia 63(6): 1108 (1971); *Hericium alpestre* f. *caucasicum* (Singer) Nikol., Acta Inst. Bot. Acad. Sci. USSR Plant. Crypt., Ser. II 5: 336 (1950); *Manina flagellum* Scop., Diss. sci. nat., Edn 1: 97 (1772); for other synonymies, see Species Fungorum [35].

**Macro- and microscopic features.** Basidioma annual, up to 20(25) cm across, fleshy, irregularly globose with short branched trunk, coral-branched, white when fresh, later creamy to pink, toward ochre with age (Fig. 2); hymenophore hydroid, with unbranched spines up to 2 cm long, pendulous, grouped into tufts on the ends of the branches, sharp at the ends (Fig. 3A). Hyphal system monomitic; hyphae with clamps, hyaline, in some specimens amyloid, often inflated [21]. Cystidia absent. Gloecystidia with a yellowish, oily content, sulfo-positive, thin-walled, fusiform or cylindrical, with an irregular and a variable number of constrictions (Fig. 3B,C), up to 5 µm wide. Basidia clavate, with four sterigmata and a basal clamp, 25–30(–40) × (4–)5–6 µm. Basidiospores subglobose to



**Fig. 2** *Hericium flagellum* basidioma growing on a fallen log of *Abies alba* in the “Olbina” nature reserve (November 9, 2017; photograph: M. Kujawska).

broadly ellipsoid, thick-walled, hyaline, amyloid, some containing oil droplets, almost smooth (under LM) to minutely verrucose (under SEM) (Fig. 3B–D), (5–)5.2–6.0(–6.6) × 4.4–5(–5.4) μm.

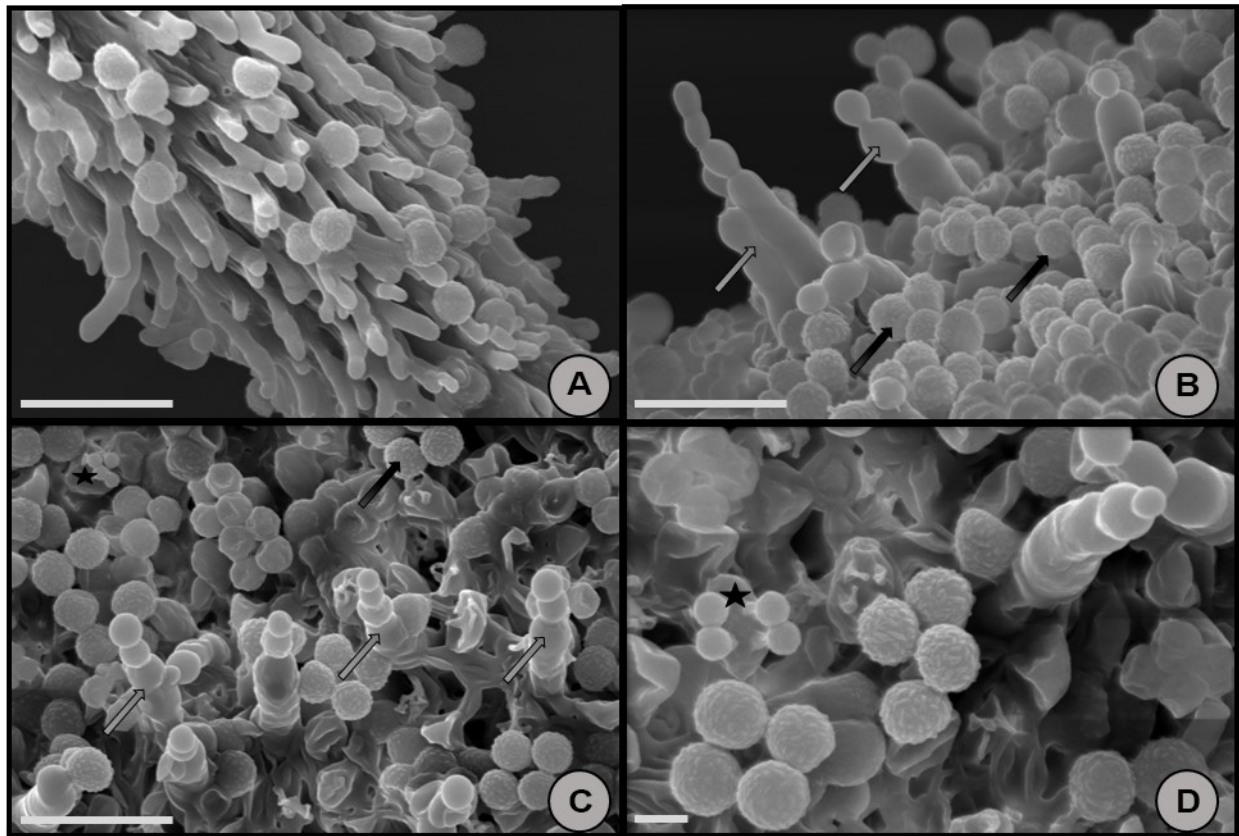
#### New locality of *Hericium flagellum*

*Hericium flagellum* was first observed in the “Olbina” reserve in early November 2016. A single mature basidioma was found growing in the hollow of an old, broken, rotting silver fir trunk located near an educational trail. The specimen of *H. flagellum* was approximately 10–12 cm in diameter, cream-white, with numerous branches spreading from a short stalk and terminating in sharp-tufted spines up to 7 mm long. *Hericium flagellum* was again observed in the reserve in early November 2017, approximately 100 m from the location of the first record. This time, the basidioma grew on a recently fallen, thick log of old silver fir and was much more spectacular: the diameter of the basidioma hidden among branches was approximately 25 cm. The ochre-colored stalk branched repeatedly to form pinkish “twigs” terminating in tufts of long (up to 15 mm), snow-white, pendulous spines (Fig. 2).

#### Discussion

In spite of its wide distribution range, *H. flagellum* is regarded as rare [15,26,27,38]. Both in Poland and in many other European countries, this fungus is included on the red lists of fungi and assigned to various threat categories, e.g., E (critically endangered) in Poland [39], EN (endangered) in Bulgaria [40] and Croatia [41], VU (vulnerable) in Austria [18] and Switzerland [42], NT (near threatened) in the Czech Republic [43], R (rare) in Ukraine [27], and “rare” or “near threatened” in Russia, depending on the region [44,45]. In Germany, *H. flagellum* is ranked as threatened in various threat categories depending on the federal state [46–48]. *Hericium flagellum* is a species





**Fig. 3** Scanning electron micrographs of *Hericium flagellum*. (A) Ending of the spine; (B–D) gloeocystidia (white arrows) and basidiospores (black arrows); star – basidium with immature basidiospores. Scale: (A) 10 µm; (B) 2 µm; (C) 10 µm; (D) 10 µm. Photographs: M. Bihun and B. Bialecka.

proposed for inclusion on the Global Fungal Red List [49]. In Poland, *H. flagellum* has been protected by law since 1983 [50]; however, since 2014 the species has been under partial protection only [51]. The first critical review of the occurrence of *H. flagellum*, mostly from the southern part of Poland, was published in 2003 by Wojewoda in the *Checklist of Polish larger Basidiomycetes* [1]. Afterward, several reports on the occurrence of *H. flagellum* in Poland have appeared [4,52–57]. Up to now in Wielkopolska Voivodship, *H. flagellum* has been reported from only once from “Dęбно” reserve near Rawicz [58], situated slightly outside the northern limits of the natural range of silver fir. Basidiomata of *H. flagellum* were found on the deadwood of Scots pine at this location and this is the only published record of *H. flagellum* on such a substrate. However, the lack of herbarium material from that study (Kubiak 2019, personal communication) does not allow for its verification; therefore, we did not include this finding on the distribution map of *H. flagellum* in Wielkopolska Voivodship.

Our new records of *H. flagellum* are an interesting aspect of research on species diversity of fungi associated with silver fir, conducted within our project aiming to determine the diversity of macrofungi in continental mixed coniferous forest [59]. It is worth noting that during mycological research in the “Olbina” reserve, we discovered specimens of another valuable fungal species associated with silver fir, i.e., *Hymenochaete cruenta* [60], suggesting that the “Olbina” reserve is a local hot-spot of rare fungal species associated with silver fir wood.

The substantial contribution of silver fir in the forest stand of the “Olbina” nature reserve and the significant amount of deadwood in the form of thick logs and trunks provide conditions conducive for the development of additional *H. flagellum* basidiomata in the future. The exceptional shape and size of the basidiomata of this species draws the attention of forest visitors. Although the fungus is edible, the basidiomata are not attractive to mushroom-pickers because there is no tradition to picking *H. flagellum* for household consumption. Additionally, *H. flagellum* is protected by law. Therefore, occurrences of *H. flagellum* in the “Olbina” reserve seem not to be threatened.

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## References

1. Wojewoda W. Checklist of Polish larger Basidiomycetes. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2003. (Biodiversity of Poland; vol 7).
2. Breitenbach F, Kranzlin F. Fungi of Switzerland 2. Heterobasidiomycetes, Aphyllophorales, Gasteromycetes. Luzern: Verlag Mykologia; 1986.
3. Kreisel H. Pilzflora der Deutschen Demokratischen Republik Basidiomycetes (Gallert-, Hut- und Bauchpilze). Jena: G. Fischer; 1987.
4. Kujawa A, Gierczyk B. Rejestr gatunków grzybów chronionych i zagrożonych w Polsce. Część III. Wykaz gatunków przyjętych do rejestru w roku 2007. Przegląd Przyrodniczy. 2010;21(1):8–53.
5. Николаева [Nikolaeva] ТЛ [TL]. Флора споровых растений СССР. Том 6. Грибы. Часть 2. Ежовиковые грибы [Flora sporovych rastenij SSSR. Tom 6. Griby. Chast' 2. Ezhovikovye griby]. Москва [Moskva]: Издательство Академии наук СССР [Izdatel'stvo Akademii nauk SSSR]; 1961.
6. Sałata B. Badania nad udziałem grzybów wyższych w lasach bukowych jodłowych w Roztoczu Środkowym. Acta Mycol. 1972;8(1):69–139. <https://doi.org/10.5586/am.1972.009>
7. Lisiewska M. Macromycetes na tle zespołów leśnych Świętokrzyskiego Parku Narodowego. Acta Mycol. 1978;14(1–2):163–191. <https://doi.org/10.5586/am.1978.010>
8. Lisiewska M. Flora macromycetes Świętokrzyskiego Parku Narodowego. Acta Mycol. 1979;15(1):21–43. <https://doi.org/10.5586/am.1979.003>
9. Bujakiewicz A. Grzyby Babiej Góry. I. Mikoflora lasów. Acta Mycol. 1979;15(2):213–294. <https://doi.org/10.5586/am.1979.012>
10. Wojewoda W, Kozak M, Mleczko P, Karasiński D. Grzyby makroskopijne Gorców (Karpaty Zachodnie). Kraków: Instytut Botaniki im. W. Szafera PAN; 2016.
11. Sałata B, Ostas T. Nowe stanowiska interesujących grzybów wyższych (macromycetes) w południowo-wschodniej Polsce. Fragmenta Floristica et Geobotanica – Materiały Florystyczne i Geobotaniczne. 1975;21(4):521–526.
12. Flisińska Z, Sałata B. Materiały do poznania flory grzybów wielkoowocnikowych (macromycetes) kilku regionów południowo-wschodniej Polski. Annales Universitatis Mariae Curie-Skłodowska, Sectio C – Biologia. 1991;46(2):13–19.
13. Wojewoda W. Macromycetes Ojcowskiego Parku Narodowego. Acta Mycol. 1974;10(2):181–265. <https://doi.org/10.5586/am.1974.007>
14. Bujakiewicz A. Grzyby Babiej Góry. II. Wartość wskaźnikowa macromycetes w zespołach leśnych. A. Uwagi wstępne i charakterystyka lasów regla dolnego. Acta Mycol. 1981;17(1–2):63–125. <https://doi.org/10.5586/am.1981.006>
15. Chachuła P. Aktualny stan wiedzy o grzybach chronionych w świetle zmienionych aktów prawnych i stwierdzonych nowych gatunków i stanowisk na terenie Pienińskiego Parku Narodowego. Pieniny – Przyroda i Człowiek. 2016;14:91–100.
16. Kozłowska M, Mułenko W, Anusiewicz M, Mamczarz M. An annotated catalogue of the fungal biota of the Roztocze Upland. Richness, diversity and distribution. Lublin: UMCS; 2019.
17. Rudawska M, Pietras M, Smutek I, Strzeliński P, Leski T. Ectomycorrhizal fungal assemblages of *Abies alba* Mill. outside its native range in Poland. Mycorrhiza. 2015;26:57–65. <https://doi.org/10.1007/s00572-015-0646-3>
18. Damon W, Krisai-Greilhuber I. Die Pilze Österreichs. Verzeichnis und Rote Liste 2016. Teil: Makromyzeten. Wien: Herausgeber: Österreichischen Mycologischen Gesellschaft; 2017.
19. Gyosheva M, Georgieva P. Macrofungi of the Parangalitsa Biosphere Reserve in Rila Mts, Bulgaria. In: Ivanova D, editor. Plant, fungal and habitat diversity investigation and conservation. Proceedings: IV Balkan Botanical Congress; 2006 Jun 20–26; Sofia,

- Bulgaria. Sofia: Institute of Botany; 2009. p. 460–470.
20. Tortić M. Macromycetes of Gorski Kotar III. *Acta Bot Croat.* 1992;51:113–130.
  21. Bernicchia A, Gorjón SP. Corticiaceae s. l. Italy: Candusso Edizioni; 2010. (*Fungi Europaei*; vol 12).
  22. Krieglsteiner GJ. Verbreitungsatlas der Grosspilze Deutschlands (West). Band 1: Ständerpilze. Teil A: Nidblatterpilze. Stuttgart: Ulmer; 1991.
  23. Holec J, Bielich A, Beran M. Přehled hub střední Evropy. Praha: Academia; 2012.
  24. Hallenberg N, Nilsson RH, Robledo G. Species complexes in *Hericium* (Russulales, Agaricomycota) and a new species – *Hericium rajchenbergii* – from southern South America. *Mycol Prog.* 2013;12:413–420. <https://doi.org/10.1007/s11557-012-0848-4>
  25. Kunca V. Vzácné drevné huby z pralesovitých spoločenstiev Slovenska. Drevoznehodnocujúce huby 2018: vedecký recenzovaný zborník vydaný pri príležitosti životného jubilea prof. Ing. Ladislava Reinprechta, CSc. a prof. RNDr. Jána Gápera, CSc. Zvolen: Technická univerzita vo Zvolene; 2018.
  26. Rocabrana A, Vila J, Tabarés M, Ballarà J. Aportación a la micoflora de los pirineos y Pre-Pirineos de Cataluña. II. Algunas especies asociadas al abeto (*Abies alba*). *Rev Catalana Micol.* 1996;(5)19:155–168.
  27. Bisko NA, Sukhomlyn MM, Mykchaylova O, Lomberg ML, Tsvyd NV, Petrichuk YuV, et al. Ex situ conservation of rare and endangered species in mushroom culture collections of Ukraine. *Ukr Bot Z.* 2018;75(4):338–347.
  28. Bujakiewicz A. Grzyby wielkoowocnikowe Babiogórskiego Parku Narodowego. In: Wołoszyn BW, Jaworski A, Szwaagrzyk J, editors. Babiogórski Park Narodowy. Monografia przyrodnicza. Kraków: Babiogórski Park Narodowy, Komitet Ochrony Przyrody PAN Instytutu Systematyki i Ewolucji Zwierząt PAN; 2004. p. 215–257.
  29. Łuszczynski J. Grzyby wielkoowocnikowe. In: Cieśliński S, Kowalkowski A, editors. Świętokrzyski Park Narodowy. Przyroda, gospodarka, kultura. Bodzentyn: Świętokrzyski Park Narodowy; 2000. p. 267–277.
  30. Ginns J. *Hericium* in North America: cultural characteristics and mating behaviour. *Can J Bot.* 1985;63:1551–1563. <https://doi.org/10.1139/b85-215>
  31. Krawiec F. Rezerat jodłowy na południe od Kalisza. *Kwartalny Biuletyn Informacyjny, C, Rezerwaty.* 1937;7(4):6–7.
  32. Matuszkiewicz W. Przewodnik do oznaczania zbiorowisk roślinnych Polski. Warszawa: Wydawnictwo Naukowe PWN; 2001.
  33. Węgiel A, Górski P, Janyszek S, Mendzikowski S, Patalan I, Urbański P, et al. Plan ochrony rezerwatu przyrody “Olbina” położonego w nadleśnictwie Kalisz. Poznań: Wydział Środowiska i Rolnictwa, Wielkopolski Urząd Wojewódzki; 2006.
  34. Index Fungorum [Internet]. 2019 [cited 2019 Nov 6]. Available from: <http://www.indexfungorum.org/names/NamesRecord.asp?RecordID=469436>
  35. Species Fungorum [Internet]. 2019 [cited 2019 Nov 6]. Available from: <http://www.speciesfungorum.org/GSD/GSDspecies.asp?RecordID=469436>
  36. Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M, editors. Flowering plants and pteridophytes of Poland. A checklist. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2002. (*Biodiversity of Poland*; vol 1).
  37. Wojewoda W. Atlas of the geographical distribution of fungi in Poland. Vol. 1. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2000.
  38. Krotoski T. Chronione i rzadkie gatunki grzybów wielkoowocnikowych stwierdzone na Płaskowyżu Rybnickim w roku 2005. *Natura Silesiae Superioris.* 2007;10:37–44.
  39. Wojewoda W, Ławrynowicz M. Red list of the macrofungi in Poland. In: Mirek Z, Zarzycki K, Wojewoda W, Szelaż Z, editors. Red list of plants and fungi in Poland. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2006. p. 65.
  40. Gyosheva M, Natcheva R, Lambewska-Hristova A. New data about macrofungal species diversity in Bulgaria. *Phytol Balc (Sofia).* 2018;24(3):305–313.
  41. Gyosheva M, Denchev C, Dimitrova E, Assyov B, Petrova R, Stoichev G. Red list of fungi in Bulgaria. *Mycol Balc.* 2006;3:81–87.
  42. Senn-Irlet B, Bieri G, Egli S. Rote Liste der gefährdeten Grosspilze der Schweiz. Bern: BAFU, WSL; 2007. (*Umwelt-Vollzug*; vol 0718).
  43. Holec J, Beran M, editors. Červený seznam hub (makromycetů) České republiky. Praha

- Agentura Ochrony Prirody a Krajiny; 2006. (Příroda; vol 24).
44. Zamotajlov AS, editor. Red data book of Republic of Adygheya. Rare and threatened representatives of the regional fauna and flora. Part 1. Introduction, Vegetabilia and Mycota. 2nd ed. Maykop: Kachestvo; 2012.
  45. Черешнев [Chereshnev] ИА [IA], Андреев [Andreev] АВ [AV], Берман [Berman] ДИ [DI], Докучаев [Dokuchaev] НЕ [NE], Кашин [Kashin] ВА [VA], Полежаев [Polezhaev] АН [AN], editors. Красная книга Магаданской области: редкие и находящиеся под угрозой исчезновения виды растений и животных [Krasnaja kniga Magadanskoj oblasti redkie i nahodjashiesja pod ugrozoi ischeznovenija vidy rastenij i zhivotnyh]. Магадан [Magadan]: ИБП Севера ДВО РАН [IBP Severa DVO RAN]; 2008.
  46. Ludwig G, Haupt H, Gruttke H, Binot-Hafke M. Methodische Anleitung zur Erstellung Roter Listen gefährdeter Tiere, Pflanzen und Pilze. BfN-Skripten Bd. 191: 1–98 [Internet]. 2006 [cited 2019 Aug 27]; Available from: <http://www.nationalredlist.org/species-information/?speciesID=278082>
  47. Karasch P, Hahn C. Rote Liste gefährdeten Großpilze Bayerns. Augsburg: Bayerisches Landesamt für Umwelt [Internet]. 2009 [cited 2019 Aug 27]. Available from: [http://www.nationalredlist.org/files/2016/09/roteliste\\_grosspilze-BAY.pdf](http://www.nationalredlist.org/files/2016/09/roteliste_grosspilze-BAY.pdf)
  48. Hardtke HJ, Otto P. Rote Liste Pilze. Materialien zu Naturschutz und Landschaftspflege. Dresden: Sächsisches Landesamt für Umwelt und Geologie; 1999.
  49. The Global Fungal Red List Initiative [Internet]. 2019 [cited 2019 Aug 26]. Available from: [http://iucn.ekoo.se/iucn/species\\_view/224021/](http://iucn.ekoo.se/iucn/species_view/224021/)
  50. Rozporządzenie Ministra Leśnictwa i Przemysłu Drzewnego z dnia 30 kwietnia 1983 r. w sprawie wprowadzenia gatunkowej ochrony roślin. Journal of Laws of the Republic of Poland (Dziennik Ustaw), 1983 May 20, Item 134.
  51. Rozporządzenie Ministra Środowiska z dnia 9 października 2014 r. w sprawie ochrony gatunkowej grzybów. Journal of Laws of the Republic of Poland (Dziennik Ustaw), 2014 Oct 9, Item 1408.
  52. Kujawa A, Gierczyk B. “Rejestr gatunków grzybów chronionych i zagrożonych” – nowa forma gromadzenia danych mikologicznych pochodzących od amatorów. Podsumowanie roku 2005. Przegląd Przyrodniczy. 2005;16(3–4):17–52.
  53. Kujawa A, Gierczyk B. Rejestr gatunków grzybów chronionych i zagrożonych w Polsce. Część V. Wykaz gatunków przyjętych do rejestru w roku 2009. Przegląd Przyrodniczy. 2011;22(4):16–68.
  54. Kujawa A, Gierczyk B. Rejestr gatunków grzybów chronionych i zagrożonych w Polsce. Część V. Wykaz gatunków przyjętych do rejestru w roku 2009. Przegląd Przyrodniczy. 2012;23(4):3–59.
  55. Kudławiec B, Łukasz M. Grzyby wielkoowocnikowe Macromycetes Góry Wierzejskiej w Górach Świętokrzyskich. Przegląd Przyrodniczy. 2014;25(3):3–30.
  56. Białobrzeska M, Szczepkowski A. Grzyby chronione na terenie Nadleśnictwa Zwierzyniec. Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej. 2014;16(4):177–185.
  57. Kujawa A, Gierczyk B. Rejestr gatunków grzybów chronionych i zagrożonych w Polsce. Część V. Wykaz gatunków przyjętych do rejestru w roku 2009. Przegląd Przyrodniczy. 2016;27(3):3–55.
  58. Kubiak D. Zagrożone i ściśle chronione gatunki macromycetes w rezerwacie “Dębno”. Przegląd Przyrodniczy. 2002;13(1–2):71–74.
  59. Leski T, Rudawska M, Kujawska M, Stasińska M, Janowski D, Karliński L, et al. Both forest reserves and managed forests help maintain ectomycorrhizal fungal diversity. Biol Conserv. 2019;238:108206. <https://doi.org/10.1016/j.biocon.2019.108206>
  60. Kujawska MB, Stasińska M, Leski T, Rudawska M. New locality of *Hymenochaete cruenta* in the Olbina nature reserve and revisiting of distribution of this fungus in Poland. Acta Mycol. 2016;51(2):1085. <https://doi.org/10.5586/am.1085>
  61. Gostyńska-Jakuszevska M. Jodła pospolita (*Abies alba* Mill.). In: Browicz K, editor. Atlas rozmieszczenia drzew i krzewów w Polsce. T. 12. Warszawa: Zakład Dendrologii i Arboretum Kórnickie Polskiej Akademii Nauk; 1972. p. 5–10.